

CLAIMS

1. A device for applying a pulsating pressure to a local region of the body, the device comprising a pressure chamber in to which a limb of the body can be placed to seal it from external conditions, whereby in use the limb can be immersed in a liquid contained in the pressure chamber such that the liquid surrounds and is in contact with the limb wherein an element is provided to generate pulses of pressure within the chamber that can be transmitted to the limb directly via the liquid.
2. The device as claimed in claim 1, wherein the pressure chamber comprises an elongate housing having an opening for receiving the limb and a seal arranged around the opening for sealing against the limb.
3. The device as claimed in claim 2, wherein the elongate housing is a cylindrical or box-shaped housing.
4. The device as claimed in claim 2, wherein an inlet and outlet are provided in the housing for introducing and discharging the liquid into and out of the chamber.
5. The device as claimed in claim 4, wherein the inlet and outlet are in communication with each other via a fluid path that is defined by internal walls of the chamber and the surface of the limb once it has been introduced into the chamber, such that in use liquid flows from the inlet into the chamber, circulates around and in contact with the surface of the limb and is then discharged via the outlet.
6. The device as claimed in claim 4, wherein a liquid flow transmission means is connected to the pressure chamber via the inlet and outlet to generate a flow of liquid which is circulated within the chamber and around the limb.
7. The device of claim 6, wherein the flow transmission means is a pump.

8. The device as claimed in claim 6, wherein the flow transmission means is connected to the pressure chamber via the inlet and outlet to generate a flow of liquid which is circulated within the chamber and around the limb.

9. The device as claimed in claim 1, wherein the liquid is circulated through a heat exchanger unit before it enters the pressure chamber to control the temperature of the liquid.

10. The device as claimed in claim 9, wherein the heat exchanger unit comprises a plurality of heat exchanger tubes housed within a water bath.

11. The device as claimed in claim 1, wherein a pulsating means is provided to generate pulses of pressure within the chamber and thereby exert a pulsating pressure on the surface of the limb whilst the limb is immersed in a flow of liquid.

12. The device as claimed in claim 4, wherein a pulsating means is provided to generate pulses of pressure within the chamber and thereby exert a pulsating pressure on the surface of the limb whilst the limb is immersed in a flow of liquid.

13. The device as claimed in claim 6, wherein a pulsating means is provided to generate pulses of pressure within the chamber and thereby exert a pulsating pressure on the surface of the limb whilst the limb is immersed in a flow of liquid.

14. The device as claimed in claim 9, wherein a pulsating means is provided to generate pulses of pressure within the chamber and thereby exert a pulsating pressure on the surface of the limb whilst the limb is immersed in a flow of liquid.

15. The device as claimed in claim 11, wherein one or more connections are provided in an upper region of the pressure chamber, coupled via a Y-connector, to communicate the chamber with a pressure source which is at a pressure different from atmospheric pressure for regulating the pressure within the chamber.

16. The device as claimed in claim 15, wherein said pressure source is a suction device, preferably a vacuum pump or vacuum line.

17. The device as claimed in claim 16, wherein said pressure source is set to create a negative pressure of between -20 mmHg and -80 mmHg (-2.7 kPa and -10.7 kPa), preferably -40 mmHg (-5.3 kPa).

18. The device as claimed in claim 16, wherein a valve is provided in connection with the pressure chamber, preferably between said chamber and said pressure source, to bleed air at intervals into the pressure chamber to thereby generate the pulses of negative pressure.

19. The device as claimed in claim 18, wherein the valve is controlled by a timer system to bleed air into the pressure chamber for between 2 and 15 seconds at a time.

20. The device as claimed in claim 19, wherein the valve is controlled by a timer system to bleed air into the pressure chamber for between 5 and 10 seconds at a time.

21. The device as claimed in claim 20, wherein the valve is controlled by a timer system to bleed air into the pressure chamber for 7 seconds at a time.

22. The device as claimed in claim 18, wherein the valve is controlled by the timer system to be closed for between 1 and 20 seconds at a time to allow build up of negative pressure.

23. The device as claimed in claim 22, wherein the valve is controlled by the timer system to be closed for between 5 and 15 seconds at a time to allow build up of negative pressure.

24. A device as claimed in claim 18, wherein the valve is controlled by the timer system to be closed for 10 seconds at a time to allow build up of negative pressure.

25. A method of applying a pulsating pressure to a local region of the body comprising the steps of:

providing a pressure chamber;

introducing a limb in to the pressure chamber such that it is sealed from external conditions;

filling or partially filling the pressure chamber with a liquid to immerse the limb in the liquid so that it is substantially surrounded by and in contact with the liquid; and

generating a pulsating pressure within the chamber and transmitting the pulses of pressure to the limb directly via the liquid.

26. The method as claimed in claim 25, wherein pulses of negative pressure of between -20 mmHg and -80 mmHg (-2.7 kPa and -10.7 kPa) are generated within the pressure chamber.

27. The method as claimed in claim 26, wherein pulses of negative pressure of -40 mmHg (-5.3 kPa) are generated within the pressure chamber.

28. The method as claimed in claim 26, wherein each pulse of negative pressure is generated for between 1 and 20 seconds.

29. The method as claimed in claim 28, wherein each pulse of negative pressure is generated for between 5 and 15 seconds.

30. The method as claimed in claim 29, wherein each pulse of negative pressure is generated for 10 seconds.

31. The method as claimed in claim 28, wherein the negative pressure is released for an interval of between 2 and 15 seconds at a time to create the pulses of negative pressure.

32. The method as claimed in claim 29, wherein the negative pressure is released for an interval of between 5 and 10 seconds at a time to create the pulses of negative pressure.

33. The method as claimed in claim 30, wherein the negative pressure is released for 7 seconds at a time to create the pulses of negative pressure.

34. The method as claimed in claim 25, wherein the liquid is circulated within the pressure chamber to generate a flow of liquid which is in direct contact with the limb.

35. The method as claimed in claim 26, wherein the liquid is circulated within the pressure chamber to generate a flow of liquid which is in direct contact with the limb.

36. The method as claimed in claim 28, wherein the liquid is circulated within the pressure chamber to generate a flow of liquid which is in direct contact with the limb.

37. The method as claimed in claim 31, wherein the liquid is circulated within the pressure chamber to generate a flow of liquid which is in direct contact with the limb.

38. The method as claimed in claim 25, wherein the temperature of the liquid is controlled by a heat exchanger unit to be at a temperature either above or below the core body

5 temperature of the patient.

39. The method as claimed in claim 38, wherein the liquid is maintained at a temperature of less than 30°C whilst the pulsating pressure is applied to the limb.

40. The method as claimed in claim 39, wherein the liquid is maintained at a temperature of less than 10°C whilst the pulsating pressure is applied to the limb.

10 41. The method as claimed in claim 38, wherein the liquid is maintained at a temperature greater than 43.5°C whilst the pulsating pressure is applied to the limb.

42. The method as claimed in claim 41, wherein the liquid is maintained at a temperature greater than 45°C whilst the pulsating pressure is applied to the limb.

15 43. The method as claimed in claim 24, wherein said method is being applied to the limb of the patient to control or regulate the temperature of the patient.

44. The method as claimed in claim 25, wherein the method includes the step of providing a regional anaesthesia to the limb.

45. A method for effecting a change in the core body temperature of a patient comprising:
transferring thermal energy to or from a limb through a liquid medium whilst
20 subjecting the limb to a pulsating pressure generated through the liquid medium; and
administering one or more anaesthetic agents to the patient prior to the transfer of
thermal energy to reduce sympathetic responses in the limb of the patient.

46. The method for effecting a change in the core body temperature of a patient as claimed in claim 45, wherein the pulsating pressure is a pulsating negative pressure.

47. A device for applying a pulsating pressure to an area of skin on a limb of a body comprising a pressure chamber into which the limb can be inserted, a barrier layer of flexible material housed within that chamber for form-fitted engagement against the skin, the barrier layer defining an inner region within the pressure chamber for receiving the limb which is separated from a flow of liquid within the chamber, wherein the device includes an element or means for generating a pulsating pressure within the pressure chamber, and an element or means for generating a negative pressure between the barrier layer and the area of skin to maintain the barrier layer in contact with the area of skin.

48. A method of treating hypothermia in a human body by applying a pulsating pressure to a local region of that body comprising the steps of:

providing a pressure chamber;

introducing a limb in to the pressure, chamber such that it is sealed from external conditions;

filling or partially filling the pressure chamber with a liquid to immerse the limb in the liquid so that it is substantially surrounded by and in contact with the liquid;

circulating the liquid via a heat exchanger unit to heat the liquid to a temperature of 40°C or above; and

generating pulses of negative pressure within the chamber of between -20 mmHg and -80 mmHg (-2.7 kPa and -10.7 kPa), preferably -40 mmHg (-5.3 kPa), each pulse of negative pressure being generated for between 1 and 20 seconds and released for an interval of between 2 and 15 seconds the pulses of negative pressure and thermal energy in the liquid being transmitted simultaneously to the limb of the patient via the direct contact with the liquid.

49. The method of treating hypothermia in a human body as claimed in claim 48, wherein the negative pressure is generated for 10 seconds and then released for 7 seconds.

50. A method of treating hyperthermia in a human body by applying a pulsating pressure to a local region of that body comprising the steps of:

providing a pressure chamber;

introducing a limb in to the pressure, chamber such that it is sealed from external

5 conditions;

filling or partially filling the pressure chamber with a liquid to immerse the limb in the liquid so that it is substantially surrounded by and in contact with the liquid;

circulating the liquid via a heat exchanger unit to cool the liquid to a temperature of 30°C or less; and

10 generating pulses of negative pressure within the chamber of between -20 mmHg and -80 mmHg (-2.7 kPa and -10.7 kPa), preferably -40 mmHg (-5.3 kPa), each pulse of negative pressure being generated for between 1 and 20 seconds and released for an interval of between 2 and 15 seconds the pulses of negative pressure and thermal energy in the liquid being transmitted simultaneously to the limb of the patient via the direct contact with the
15 liquid.

51. The method of treating hyperthermia in a human body as claimed in claim 50, wherein the negative pressure is generated for 10 seconds and then released for 7 seconds.

52. A method of increasing blood flow to a local region of the body, comprising:

providing a pressure chamber;

20 introducing the local region of the body into the pressure chamber such that the local region is sealed from external conditions;

introducing liquid into the pressure chamber so that the local region of the body is substantially surrounded by and in direct contact with the liquid; and

alternately generating and releasing negative pressure within the chamber, the negative
25 pressure being transmitted to the local region through direct contact with the liquid.

53. The method of claim 52, wherein the alternately generating and releasing of negative pressure comprises alternately generating negative pressure for a predetermined time interval of 1 to 20 seconds and releasing the negative pressure for a predetermined time interval of 2 to 15 seconds.

5 54. The method of claim 53, wherein the alternately generating and releasing negative pressure within the chamber comprises alternately generating negative pressure for a time interval of about 10 seconds and releasing the negative pressure for a time interval of about 7 seconds.

10 55. The method of claim 52, wherein the alternately generating and releasing pulses of negative pressure within the chamber comprises alternately generating a negative pressure between about -20mmHg and -80mmHg and releasing the negative pressure.

56. The method of claim 55, wherein the alternately generating and releasing pulses of negative pressure within the chamber comprises alternately generating a negative pressure of about -40mmHg and releasing the negative pressure.

15 57. The method of claim 52, wherein the introducing liquid into the pressure chamber comprises introducing liquid having a temperature different than the core body temperature.

58. The method of claim 52, further comprising the step of circulating the liquid around the surfaces of the local region of the body to transfer heat to or from the local region.

20 59. The method of claim 52, further comprising administering an anesthetic to the local region prior to introducing the local region into the pressure chamber.

60. The method of claims 52, wherein the local region is a limb.

61. A method of applying a pulsating negative pressure to a local region of the body, comprising:

providing a pressure chamber containing a gas;

introducing a limb into the pressure chamber such that the limb is sealed from external conditions;

partially filling the pressure chamber with a liquid so that the limb is substantially surrounded by and in direct contact with the liquid while leaving a gas pocket above the liquid
5 in an upper region of the chamber;

continuously supplying a constant negative pressure into the gas pocket; and
introducing a positive pressure into the gas pocket at predetermined time intervals to temporarily release negative pressure within the chamber.

62. A method of transferring thermal energy to and from a body, comprising:

10 providing an enclosure;

introducing a limb into the enclosure such that the limb is sealed from external conditions;

introducing thermal exchange liquid into the chamber so that the limb is completely surrounded by and in direct contact with the liquid, the introduced thermal exchange liquid

15 having a predetermined temperature different than the core body temperature;

circulating the introduced thermal exchange liquid around the surfaces of the limb, the liquid transmitting heat to or from the limb; and

generating a pulsating pressure within the enclosure, the pulsating pressure being transmitted to the limb through direct contact with the thermal exchange liquid.

20 63. The method of claim 62, wherein generating the pulsating pressure comprises alternately generating and releasing a negative pressure within the enclosure.

64. The method of claim 63, wherein the alternately generating and releasing negative pressure within the chamber comprises alternately generating negative pressure for a time interval of between about 5 and 15 seconds and releasing the negative pressure for a time

25 interval of between about 5 and 10 seconds.

65. The method of claim 64, wherein the alternately generating and releasing negative pressure within the chamber comprises alternately generating negative pressure for a time interval of about 10 seconds and releasing the negative pressure for a time interval of about 7 seconds.

5 66. The method of claim 62, wherein the alternately generating and releasing pulses of negative pressure within the chamber comprises alternately generating a negative pressure between about -20mmHg and -80mmHg and releasing the negative pressure.

67. The method of claim 66, wherein the alternately generating and releasing pulses of negative pressure within the chamber comprises alternately generating a negative pressure of
10 about -40mmHg and releasing the negative pressure.